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ABSTRACT

This study examined the ability of preschool children to process and use conceptual category information in a discrimination learning task. A total of 60 boys and girls between the ages of 2 1/2 and 4 years completed a 3-choice discrimination learning task. On each of 12 trials, a child was presented with three magazine photographs: one of an animal, one of an item of food, and one of an item of clothing. The positive instance on every trial was a member of the same conceptual category (either food or animal). Half of the children were initially given an example of the kind of stimulus which would be reinforced and half had to learn the conceptual rule through trial and error. Subsequently the children were given sorting, labeling, and concept identification tasks. Between 70%-100% of children at all ages used the category information to solve the discrimination learning task. Children who had been required to discover the conceptual rule independently did as well as those who had not. Even the 2 1/2-year-olds demonstrated the ability to spontaneously recognize and utilize a conceptual rule. Certain performance measures indicated an improvement over age. It was suggested that this progression is primarily related to the speed with which a conceptual strategy is adopted rather than the ability to use the conceptual information. This paper discusses a number of methodological issues involving the clarification of tasks for child subjects. (Author/MS)

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THE USE OF CATEGORY INFORMATION BY 2- and 3- YEAR-OLDS

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THE USE OF CATEGORY INFORMATION BY
2- and 3- YEAR OLDS

Psychologists have long looked at children's abstraction abilities in an attempt to understand the way in which children perceive and organize their world. Werner (1948) suggested that the ability to abstract is present throughout life but undergoes qualitative changes with age. From the object sorting and classification work of Welch (1940), Goldstein and Scheerer (1941), and Werner (1948), Sigel (1953) hypothesized a gradual progression from a perceptual to a conceptual level of abstraction with age. Having studied the cognitive processes of children in their middle years (i.e., approximately 4-12), Bruner (1957, 1966) and his colleagues have reported that the younger child focuses primarily upon perceptual properties of stimuli while the older child comes to focus upon more abstract attributes, organizing conceptually and making inferences "beyond the information given."

Wohlwill (1962) has suggested a transition from perception to inference with age. He proposed that as the child gets older, s/he becomes more able to "supplement or replace the sensory data with information or knowledge not contained in the immediate stimulus field" (p. 84). Wohlwill characterized the developmental changes in the child's mental processes as involving a "decreasing dependence of behavior on information in the immediate stimulus field" as a function of "an increase in powers of abstraction or an increased intervention of symbolic processes" (Wohlwill, 1962, p. 73).

A number of studies have focused upon the development of conceptual thought in children during the years of approximately 4 to 10. However, until recently, relatively little work has examined these processes in younger children (e.g., 2-3 year olds). Findings had simply been extrapolated to this younger group under the assumption that if 4-year-olds were incapable of a given cognitive behavior, the same would be true of younger children. However, certain logical

capacities which had previously been assumed absent in 4- and 5-year-olds have recently been demonstrated by children as young as 2- and 3-years-old (e.g., Gelman, 1969; Mehler & Bever, 1967). We have just recently begun to delineate the many performance factors which have been distorting our perceptions of the competence of very young children. Furthermore, concepts such as "growth error" (Bruner et al., 1966) highlight the necessity for us to refrain from generalizing apparent cognitive short-comings of older children to those who are younger.

There is, in fact, striking support that very young children will use conceptual organization in recall tasks. Rossi and Rossi (1965) presented 2- to 5-year-olds a list of words, certain of which were related to one another by category. They found that even 2 year olds recall the members of one category together as a group; that is, they "cluster" words by category rather than recalling them in the order in which they were originally presented. Goldberg, Perlmutter and Myers (1974) presented 2-year-olds with boxes each containing a pair of either categorically related or unrelated objects. The children recalled both more items and more pairs of items from the related than from the unrelated sets.

But while recall tasks have suggested that very young children are using conceptual category information, other problem solving tasks have failed to support this notion. Most notably, learning tasks, e.g., conceptual discrimination learning tasks, have failed to demonstrate that young children can use category membership to facilitate learning (e.g., Daehler & Bukatko, 1974). Research has long reported that, as a function of a highly concrete, perceptual level of thought, young children are highly distractable and show a variety of task-irrelevant behaviors and error factors in learning (e.g., Harlow, 1950· 1959). More specifically, stimulus and response biases have been reported for children of this age (e.g., Gellerman, 1933; Graham, Ernhart, Craft & Berman, 1964) and

again have been assumed to reflect the highly concrete perceptual organization of the young child's thought.

Upon closer examination, however, it appears that the young child's failure to use conceptual information in learning tasks may actually reflect methodological difficulties with the research rather than true cognitive limitations of the children. It could be argued that the solutions of previous experimental tasks have not been ones which necessitated nor perhaps were even dramatically facilitated by a subject's use of the relevant conceptual information. The present study attempted to assess the young child's ability to use conceptual skills in a learning task in which the expression of these skills was both feasible and functional.

As Bruner, Goodnow and Austin (1956) have suggested, categorization is an adaptive tool. It is used to organize and simplify our world in that it allows us to rely on rules for relating to our environment (rather than having to relate to each new stimulus as a novel experience). In light of the functional nature of concepts, our attempt to reveal the young child's ability to use conceptual information in discrimination learning must employ a task in which the conceptual categories are truly functional in aiding performance.

The possibility of a memory factor need also be considered. Children's failure to use category information in discrimination problems is typically confounded with requirements that they remember their earlier responses. A failure to use conceptual category information in this setting cannot be distinguished from a failure to recall previously reinforced responses. This is not to argue that 2 and 3 year olds are incapable of such a memory task. However, the work of Flavell and his colleagues has demonstrated that young children often fail to implement memory strategies even when they are quite capable of doing so (e.g., Corsini, Pick & Flavell, 1968; Keeney, Cannizzo & Flavell, 1967; Moely, Olson, Halwes & Flavell, 1969), or even when they are told that they will have to

remember the information later (Appel, Cooper, McCarrell, Sims-Knight, Yussen & Flavell, 1972). It is therefore necessary to create an experimental paradigm in which a memory factor will not confound the results.

Another issue to be considered is related to Schadler's (1973) distinction between the ability to use versus the ability to discover a conceptual rule. In dealing with oddity tasks, Schadler found that the young child's difficulty was primarily with discovering rather than with using the relational component. This distinction may also be relevant to the typically poor performance of young children on other conceptual discrimination learning problems. Children may be quite capable of using conceptual information but may have difficulty in independently discovering a conceptual rule. Consequently, the present study has compared competence in rule utilization with competence in rule discovery.

Method

Subjects

Sixty day-care children from ethnically diverse middle- and working-class families were tested individually by a female experimenter in a quiet room at the center which the child attended. The sample included 10 males and 10 females from each of three age groups: (a) 2 1/2 - 3 years ($\bar{X}$ = 32.1 mos.); (b) 3 - 3 1/2 years ($\bar{X}$ = 38.7 mos.); and (c) 3 1/2 - 4 years ($\bar{X}$ = 45.2 mos.).

Materials

An upright panel (60 cm x 75 cm) was placed on a table between the experimenter and the subject. The panel was shaped and painted to resemble a house. Extending from the "house" panel were 14 equally-spaced metal hooks all within reach of the child.

The stimuli consisted of 40 wooden cards (12 cm x 12 cm) each of which had a magazine photograph of either an animal, an item of food, or an item of clothing. Pretesting confirmed that 2 year olds were familiar with all pictured items. Perceptual characteristics (e.g., color, shape, size) were matched across stimulus categories and varied within each category. Each card had a hole at its top so that it could be hung from a hook on the "house" panel.

A hand puppet was operated by the experimenter above the "house." The puppet encouraged the child to respond and provided social reinforcement.

Procedure

Five males and five females from each age group were randomly assigned to one of two Rule Information conditions: (a) Rule Discovery, or (b) Rule Utilization. Children completed a 12 trial, 3-choice discrimination learning (DL) task under one of these two conditions. Children were then given a series of three additional tasks: (a) sorting, (b) labeling, and (c) identification. The entire testing session required approximately 15-20 minutes.

Discrimination learning. After the experimenter and the child had gotten acquainted, the child was introduced to the puppet, "Judy," and the puppet's house (the house-shaped panel). The experimenter asked the child if s/he would help Judy by hanging pictures of the things Judy liked on her house. It was explained that s/he would be shown a number of pictures and she was to "choose the picture of the kind of thing that Judy likes best so that [s/he] can hang it on her house for her." The puppet repeated these instructions and encouraged the child to respond. No demonstrations were necessary for any of the children.

On each trial, three pictures (one from each category, food, animal, and clothing) were placed in a row on the table in front of the child. The position of each category in relation to the others varied from trial to trial in a predetermined random order. The position and sequence of stimuli from trial to trial was identical for all children.

The experimenter asked the child to choose the picture of the kind of thing which Judy liked best. For half the children the "food" stimulus was always the correct answer; for the remainder, "animal" was always the reinforced response. Following an incorrect response, both the experimenter and puppet explained that the child had not chosen the picture that Judy liked best. The child was asked to choose again, and this procedure was continued until s/he responded correctly. Following the correct response, both the experimenter and the puppet gave verbal reinforcement and the child was asked to hang the picture on Judy's house. Without further comment the child was then presented with a set of three new stimuli and the procedure was repeated.

New trials continued until the child made five consecutive correct first responses (criterion) or for a maximum of 12 trials. Following each correct response, the child hung the correct stimulus on the puppet's house (along with the previously reinforced choices). This house was kept within full view of the child throughout the DL task.

Children performed the DL task under one of two Rule Information conditions:

(a) Rule Discovery -- the child was told,

> Judy likes one special kind of thing. Now I'm going to show you some pictures and you have to figure out what that special thing is so that you can hang the pictures of the things she likes on her house.

(b) Rule Utilization -- the instructions were identical to the Rule Discovery group. However, the experimenter then hung on Judy's house two examples of the category to be reinforced saying simply, "This is the kind of thing Judy likes." No category labels were used at any time.

Sorting task. Using the stimuli from the DL task, the experimenter placed one picture from each of the three categories in a row on the table in front of the child and said, "Put the pictures together that go together. I'm going to give you a picture and you put it on top of the pile that it goes with." The child was given

one card at a time. When s/he did not sort according to category, the experimenter explained s/he was incorrect and asked the child to respond again (until the child responded correctly). Stimuli were presented in a fixed random order identical for all children (but differing from that used in the DL task) until the child had correctly sorted all 36 pictures.

Labeling. Five stimuli were randomly drawn from each of the three categories. They were presented to the child, one at a time in a random order, and s/he was asked to label each ("What's this?").

Identification task. Three stimuli were randomly drawn from each of the three categories and were placed on the table in front of the child. The experimenter asked the child to point to each of the categories (food, animal, clothing) in turn. The order of category identifications varied from child to child.

Results

No sex differences were revealed on any measures. Nor did performance vary as a function of the particular stimulus category (in the sorting, labeling, and identification tasks) or as a function of the category reinforced (on the DL task). Thus, data were combined within each Age and Rule Information condition. On the DL task, children's first responses on trial 1 revealed no initial stimulus preferences, $\chi^2(2) = 3.8$, n.s. (only those data from the Rule Discovery group were included in the analysis since the Rule Utilization group had seen examples of "the kind of thing the puppet likes").

Use of Conceptual Information

A brief inspection of the use of differential response cues was made by examining children's first responses on trial 2. Having been reinforced for a particular response on trial 1, children might have adopted any one of several

cues for responding on trial 2. Thus, with respect to the reinforced response on trial 1, a child's response on trial 2 could reflect one of three possibilities: (a) same concept but new stimulus position, (b) same position but new concept, or (c) both new concept and new stimulus position (the use of an alternative cue or no cue at all). Table 1 presents the percent of children at each age who made each of the three types of responses. It was found that as early as trial 2, most children at all ages responded according to stimulus concept rather than according to stimulus position or no obvious rule at all, $\chi^2(2) = 23.7$, $p<.001$.

Insert Table 1 about here

If children failed to use the conceptual information in the DL task one would expect their behavior to be random from trial to trial. Since three stimulus categories were presented on each trial, it would be expected that any one of these three categories would be chosen first on approximately four of the 12 trials. For each child, it was determined whether or not s/he made significantly more correct first choices than expected by chance ($p<.05$ when 7 of the 12 first choices are correct). Table 2 presents the results for each Age and Rule condition. As can be seen, 70%-100% of all children made correct first responses significantly above chance suggesting that they were, in fact, using the category information.

Insert Table 2 about here

The probability that a child who reached criterion (five consecutive correct first responses) could have done so by chance is less than .02. However, as Table 3 indicates, 70%-100% of children in each Age and Rule condition did reach

criterion within the 12 trials. Once again, it is clearly suggested that even the youngest children were using the conceptual information in the DL task.

Insert Table 3 about here

Factors Influencing Concept Utilization

A 3 x 2 x 12 ANOVA (Age x Rule x Trial, with repeated measures on Trial) was used to compare the number of children making correct first responses in each experimental condition (see Winer, 1971, pp. 303-305, for a discussion of ANOVA of dichotomous data). A main effect for Age, F (2,54) = 3.80, $p<.05$, reflected the fact that the 3 1/2 - 4 year olds made more correct first choices over the 12 trials than either the 2 1/2 - 3 or 3 - 3 1/2 year olds, Newman Keuls, $p<.05$. On the other hand, the total number of children who made correct first choices above chance (see Table 2) did not vary as a function of either Age or Rule Information.

A main effect for Trial reflected the expected increase in the number of children making a correct first response over trials, F (11, 594) = 12.12, $p<.001$, and there was no evidence that learning curves varied from one age group to another, Trials x Age, F (22, 594) = 1.07, n.s. Finally, Rule Information appeared to be important only insofar as performance on the first trial was concerned where, as would be expected, the Rule Utilization group performed superior to the Rule Discovery group, Trials x Rule, F (11, 594) = 3.52, $p<.001$. With the exception of trial 1, Rule Information appeared to be of no consequence.

A 3 x 2 ANOVA (Age x Rule) of the number of trials to criterion also revealed an improvement in performance with Age, F (2,54) = 3.82, $p<.05$. A mean of 10.15, 9.15, and 6.75 trials were required by the youngest, middle and oldest groups respectively; see Table 4. However, a comparison of the total numbers

of children who reached criterion (Table 3) revealed no significant effects for either Age or Rule Information.

Insert Table 4 about here

Sorting Task

Neither individual nor group errors appeared to be a function of stimulus category. However, a 3 x 2 ANOVA (Age x Rule) revealed that Age was a significant determinant of number of sorting errors. A mean of 9.25, 4.05, and 2.35 errors were committed by the 2 1/2 - 3, 3 - 3 1/2, and 3 1/2 - 4 year olds respectively, F (2,54) = 7.01, $p<.01$. Furthermore, number of sorting errors correlated significantly with performance on the DL task: (a) -.64 with number of correct first responses across trials, and (b) .74 with number of trials to criterion (Pearson product-moment correlation, df = 18, $p<.01$ in each instance). As Table 5 reveals, these high correlations cannot simply be explained by the similar main effects for Age on each measure since correlations were extremely large even within each age group.

Insert Table 5 about here

Labeling and Identifications

All children demonstrated perfect performance on both the labeling and identification task. Consequently, no formal analyses of these data were made.

Discussion

This study has clearly demonstrated that very young children will process and use conceptual category information in a discrimination learning task. Most children apparently recognize the existence of the conceptual groups from nearly the onset of the learning problem, and immediately proceed to test the relevancy of the categories to the task at hand. It was seen that most children responded on trial 2 by selecting the stimulus which belonged to the same category as that reinforced on trial 1. Thus it was the conceptual rather than the perceptual cues which first gained the children's attention.

These findings are in sharp contrast to the results of earlier studies which suggested that young children fail to use category information to facilitate problem solving. However, it appears that there are certain methodological problems which may account for the young child's traditionally poor performance. These may include the relevancy of the child's skills to the experimental task and confounding memory factors.

More generally, one possibly critical distinction between this and earlier experimental procedures may be the clarity of the experimental task (an issue considered by Daehler and Bukatko, 1974). In an effort to make the testing situation interesting and understandable in the child's terms, researchers have typically imbedded the experimental task within ingenious games. While this technique is often successful in maintaining the child's attention, it may also serve to confuse the child as to his or her precise task. The conceptual discrimination learning task has typically been presented to the child in the form of a guessing game. The child is shown two stimuli and is told to select the one which s/he thinks the experimenter (or puppet) likes. With only these instructions, the child will assume that s/he is to outguess the experimenter. S/he will look for some kind of gestural cue, or sparkle of the eye, which might indicate the experimenter's

preference. Within this "guessing-game" context, the child cannot be expected to assume there is a logic which underlies the designation of correct responses from trial to trial. It is the whim of the experimenter which appears to be responsible for designating "right" and "wrong" rather than some characteristic of the stimulus itself.

In contrast, the present study was more explicit in its instructions. Children were told that the puppet liked "one special kind of thing" and they were to figure out what that kind of thing was. Thus, it was clear that some relationship existed from one trial to the next and that there was a property of the stimulus itself which defined it as "correct."

There was some evidence for an age-related increase in the tendency to use conceptual information in the learning task, resembling the findings of numerous studies which have investigated children 4 years and older. However, age-related improvements in the use of conceptual information appeared to be associated with the speed with which a conceptual rule was adopted (number of trials to criterion and number of correct first responses over trials). Measures reflecting merely the use or disuse of conceptual information did not reveal age-related changes (number of children reaching criterion and number of children choosing correctly above chance). However, this finding may simply reflect a ceiling effect in the performance of older children, or it may be a function of the greater power of the parametric vs. the nonparametric tests. In any case, no critical age between 2 1/2 and 4 was revealed at which sudden progress occurred.

The most striking finding concerning the addition of the implicit rule information was that this presumed aid was quite unnecessary. Children of all ages performed extremely well regardless of the amount of rule information they had been given. The only instance in which rule information was a factor was in determining the number of subjects who responded correctly on the first learning

trial. As expected, those children who had been given the implicit conceptual rule were more likely to make a correct first response than children without this information. Thus, even the 2 1/2 year olds were able to abstract conceptual information from two examples and immediately use this knowledge to guide their first trial responses. However, apparently after only one trial, children in the Rule Discovery condition had gained information which was equivalent to that which the implicit rule had provided others.

In conclusion, given a task in which the experimental demands are clear, 2 and 3 year olds are quite capable of using category information in discrimination learning. They are not tied to the concrete, perceptual characteristics of their surroundings nor are they totally dependent upon information in the immediate stimulus field. Rather, these children are quite capable of spontaneously making inferences beyond the information given. Moreover, they readily use this skill when confronted with a relevant problem solving situation.

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Table 1

Relationship of First Response on Trial Two to the Reinforced Response on Trial One

Age Group	Same Concept	Same Position	Neither Concept nor Position Same
2 1/2 - 3 (n=20)	55%	30%	15%
3 - 3 1/2 (n=20)	70%	20%	10%
3 1/2 - 4 (n=20)	60%	30%	10%
Total (n=60)	$61.\overline{6}\%$	$26.\overline{6}\%$	$11.\overline{6}\%$

Table 2

Percent of Children Who Made Correct First Choices

Significantly Above Chance[ab]

	2 1/2 - 3 years	3 - 3 1/2 years	3 1/2 - 4 years	$\bar{X}$
Rule Utilization	90%	70%	100%	86.$\bar{6}$%
Rule Discovery	80%	80%	100%	86.$\bar{6}$%
$\bar{X}$	85%	75%	100%	86.$\bar{6}$%

[a] $N = 60$

[b] $p < .05$

Table 3

Percent of Children who Reached Criterion (N = 60)

	2 1/2 - 3 years	3 - 3 1/2 years	3 1/2 - 4 years	$\overline{X}$
Rule Utilization	70%	70%	100%	80%
Rule Discovery	70%	80%	100%	83.$\overline{3}$%
$\overline{X}$	70%	75%	100%	81.7%

Table 4

Mean Number of Trials to Criterion (N=60)

	2 1/2 - 3 years	3 - 3 1/2 years	3 1/2 - 4 years	$\overline{X}$
Rule Utilization	10.20	9.60	6.20	8.7
Rule Discovery	10.10	8.70	7.30	8.7
$\overline{X}$	10.15	9.15	6.75	8.7

Table 5

Correlation of Number of Sorting Errors with

Discrimination Learning Task Measures (N=60)

DL task measures	2 1/2 - 3 years	3 - 3 1/2 years	3 1/2 - 4 years	All ages
Number of correct first choices across trials	-.70**	-.75**	-.46*	-.64**
Number of trials to criterion	.85**	.71**	.62**	.74**

*$p < .05$

**$p < .01$